EXPANDING THE PUBLIC ACCESS DEFIBRILLATOR PROGRAM FOR THE CITY OF LOS ANGELES

LEADING COMMUNITY RISK REDUCTION

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Abstract

Cardiovascular diseases are the number one killer of men and women in America. With sudden cardiac arrest (SCA), the sooner responders arrive on scene to treat the patient with an automated external defibrillator (AED) the greater the chance the patient will survive. In 2000, the City of Los Angeles implemented a Public Access Defibrillator (PAD) program by installing automated external defibrillators (AEDs) in several City buildings and public golf courses for use by non-emergency responders (employee or visitor). The dilemma was that the City of Los Angeles had limited public access facilities with automated external defibrillators (AED) and therefore critical emergency medical care was being delayed. As the emergency medical service provider, the Los Angeles Fire Department (LAFD) must take the lead in promoting and expanding the PAD program in high-risk public facilities.

In this study, the purpose was to expand the placement of AEDs in high-risk public access facilities. As the PAD program administrator, the LAFD would expand the cadre of instructors to educate and train individuals on the use of cardiopulmonary resuscitation (CPR) and AEDs to treat victims of sudden cardiac arrest. This was an evaluative research project. The research questions were:

1. Does early defibrillation save lives?
2. What impact does response times and Fire/Emergency Medical Service levels have on public access defibrillation?
3. What public access facilities are the most advantageous to locate AEDs?
4. What is the cost for AEDs, installation, and training?
5. Are there legal liabilities attached to the use of AEDs by the public?

The procedures employed in this research project were: a review of the literature;

personal interviews; telephonic interviews; searches of related areas via the Internet; an analysis of federal, state and local laws, regulations, policies, and standards; and an analysis of the current program.

The authors cited in the literature review suggested that thousands of lives could be saved with early defibrillation in conjunction with CPR. The data presented suggested the goal of every AED program is to deliver defibrillation to a sudden cardiac arrest victim within 3 to 5 minutes of collapse. The literature review indicated that both the federal government and state governments have enacted legislation to limit liability of both first responders and lay persons.

The findings of this research revealed that the response times of LAFD resources are not meeting National Fire Protection Association (NFPA) standards. One method of supplementing LAFD resources and reducing the risk to the community is placing AEDs in high-risk public access facilities. The research revealed that the current PAD program is insufficient in meeting the demands of a population as large as the City of Los Angeles. The research also revealed locating AEDs in areas no more than five minutes from sudden cardiac arrest victims and administering CPR before initiating defibrillation, in addition to training bystanders in CPR and AED use would increase survival rates.

As a result of the applied research project it was recommended that the LAFD partner with city officials in identifying funding to expand the PAD program. In conjunction with expanding the PAD program, additional staff members would have to be budgeted to accommodate training needs. Furthermore, the LAFD should partner with the Los Angeles Police Department (LAPD) in training police officers and placing AEDs in patrol cars. Lastly, the LAFD through its medical director would continue to manage the PAD program throughout the City of Los Angeles.

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Introduction

The Los Angeles Fire Department's Mission is to preserve life and property by controlling and extinguishing fires, enforcing all laws relating to preventing or controlling the spread of fires, and providing basic and advanced life support intervention and transportation to appropriate medical facilities.

In meeting the mission, the LAFD, like most communities around the country have invested in the American Heart Association's chain of survival for cardiac arrest victims by instituting a 911 system, training personnel, and buying fire and rescue ambulance vehicles. One valuable tool used by fire and rescue personnel to treat victims of a cardiac arrest is a defibrillator. Every type of apparatus on the LAFD whether it be a rescue, truck or engine carries an AED that can be used by trained personnel (American Heart Association, 2001).

A defibrillator is a medical device that delivers an electric shock to a patient's chest which in turn passes through the heart. This is done to terminate lethal cardiac rhythms and cause the heart to resume normal pumping activity. AEDs are called automated because they take the decision to deliver a shock out of the hands of rescuers and place it in an internal computer chip. Audible prompts tell the rescuer what to do, from attaching electrodes to the patient's chest to pushing a button to deliver a shock (Public Access Defibrillation League, 2004).

Traditionally, the ability to defibrillate was solely in the hands of emergency medical personnel. Survival depended on the Emergency Medical Services (EMS) system being contacted and arriving quickly. Unfortunately, quick EMS response isn't always possible. Even the very best EMS systems experience delays from heavy traffic, secured buildings, gated communities, large building complexes and high-rises. For example, in New York City where

emergency response teams fight extreme traffic, the average arrival time for emergency vehicles is about 12 minutes. Not surprisingly, the cardiac arrest survival rate is less than 2 percent (American Heart Association, 2001).

The City of Los Angeles faces similar challenges as New York City. Today a new generation of defibrillators, called automated external defibrillators (AEDs) makes it possible for trained lay rescuers to deliver defibrillation. Having trained lay rescuers equipped with AEDs in settings where large numbers of people congregate saves precious minutes and improves survival rates for cardiac arrest victims (American Heart Association, 2001).

In this study, the purpose is to determine if the City of Los Angeles should expand the placement of AEDs in high risk public access. Furthermore, through the LAFD, as the administrator of the PAD program, develop a cadre of instructors to educate and train individuals on the use of cardiopulmonary resuscitation (CPR) and AEDs to treat victims of sudden cardiac arrest. Although there are AEDs in Federal buildings and some City buildings for use by non-emergency responders, additional AEDs are required in other public locations to provide a better level of cardiac care for the citizens living in the City of Los Angeles. This is an evaluative research project. The research questions are:

1. Does early defibrillation save lives?
2. What impact does response times and Fire/EMS service levels have on public access defibrillation?
3. What public access facilities are the most advantageous to locate AEDs?
4. What is the cost for AEDs, installation and training?
5. Are there legal liabilities attached to the use of AEDs by the public?

Background and Significance

The LAFD is an all-risk life/safety provider offering fire and emergency medical services including patient transport for a diverse population of 3.7 million citizens encompassing a geographical area of 464 square miles (Wells, 2004). The City of Los Angeles itself is comprised of high-rise, commercial, residential, urban-wildland interface, Port of Los Angeles and Los Angeles International Airport. The LAFD operates 103 fire stations within this area with a total of 3,363 uniform personnel and 333 civilian staff (Wells, 2004). The LAFD responds to approximately 350,000 incidents on an annual basis. Of these incidents, approximately 81 percent are emergency medical related incidents the other 19 percent or approximately 66,000 incidents per year are fire related incident types (Wells, 2003).

About 220,000 people die each year from sudden cardiac arrest. Most cardiac arrests are due to abnormal heart rhythms called arrhythmias. Ventricular fibrillation (VF) is the most common arrhythmia that causes cardiac arrest. VF is a condition in which the heart's electrical impulses suddenly become chaotic, often without warning. That causes the heart's pumping action to abruptly stop. When cardiac arrest occurs, the victim loses consciousness, has no pulse and stops breathing normally. Death follows within minutes (American Heart Association, 2001).

Defibrillation is the only known therapy for VF. This technique of giving an electrical shock can restore the heart's normal rhythm if it's done within minutes of the arrest. For every minute that passes without defibrillation, a victim's chance of survival decreases by 7-10 percent. After as little as 10 minutes, very few resuscitation attempts are successful (American Heart Association, 2001).

Brain damage can start to occur in just 4 to 6 minutes after the heart stops pumping blood. Death may be prevented if the sudden cardiac arrest victim receives immediate bystander cardiopulmonary resuscitation (CPR) and defibrillation within a few minutes after collapse. CPR consists of mouth-to-mouth rescue breathing and chest compressions. It can help keep blood flowing to the heart and brain until emergency help arrives. Defibrillation can stop the abnormal, erratic rhythm and allow the heart to resume its normal rhythm (American Heart Association, 2001).

Many factors in the workplace can increase the risk of Sudden Cardiac Arrest (SCA) or limit the timely delivery of lifesaving defibrillation therapy. Several of these factors are:

1. An aging work force, particularly in industrial companies.
2. Large numbers of employees located under one roof.
3. Urban locations, which may be difficult for emergency responders to reach due to the need to negotiate traffic, staircases, elevators, escalators or crowds of people.
4. Relatively remote facilities.

Approximately 13% of deaths in the workplace are a result of SCA (SOS Technologies, 2003).

The goal of every AED program is to deliver defibrillation to a sudden cardiac arrest (SCA) victim within 3 to 5 minutes of collapse. According to the American Heart Association (AHA), early defibrillation programs greatly increase a sudden cardiac arrest victim's chance for survival. Establishing an early defibrillation program in your organization provides employees and visitors with the best chance of surviving an SCA event (American Heart Association, 2003).

In 2003, the response-time for a LAFD Advanced Life Support (ALS) unit to arrive on scene in five minutes or less occurred 32% of the time. The average time for a LAFD resource

to arrive on scene of an emergency medical incident with an AED in 2003 was 6 minutes (Wells, 2004).

On November 16, 2000 President Clinton signed into law the Cardiac Arrest Survival Act (HR 2498). The law directs placing AEDs in federal buildings. At the direction of President Clinton, the Department of Health and Human Services developed guidelines for AED placement in federal facilities. These guidelines provide a template for federal agencies to establish AED programs (Public Access Defibrillation League, 2000).

On February 10, 1999, the City Council of Los Angeles adopted a motion directing the Fire Department, City Administrative Officer (CAO) and Chief Legislative Analyst (CLA) to determine the feasibility of deploying AEDs at City facilities. On November 17, 1999 City Council recommended the formation of an AED Implementation Task Force with representation from the Fire Department, CAO and CLA. The Task Force concluded that the most expeditious way to implement a public access AED program was to establish a multi-phase program. The Task Force determined that the Fire Department would manage any City public access AED program and Dr. Marc Eckstein, Medical Director for the Fire Department would oversee the entire program (Dr. Eckstein, Personal Communication, October 12, 2004).

City Council appropriated $305,267 to fund phase one of the public access defibrillator (PAD) program. Phase one implementation placed AEDs and provided training for one City owned high rise building, all municipal golf courses and the Los Angeles Zoo. In addition, the Fire Department was funded for a new position, a public access AED program manager to assist Dr. Eckstein. On January 17, 2002 a press conference was held to announce the completion of the installation of AEDs for Phase one. Phase two placed AEDs and provided training in two other City owned high rise buildings, the Los Angeles Police Department headquarters facility,

the Los Angeles Convention Center and the downtown main Library. Since the completion of the implementation of Phase two in December of 2003, no new monies have been budgeted in 2004 for additional AED installations (Dr. Eckstein, personal communication, October 12, 2004).

This study is important to the City of Los Angeles for several reasons. First, current locations of public access defibrillators are insufficient to meet the needs of a metropolitan city such as Los Angeles. Second, response times to emergency medical incidents by LAFD resources continue to fall short of the critical 5-minute threshold. Third, increasing emergency incidents and budgetary restraints for additional resources will continue to impact LAFD response times.

This Applied Research Project (ARP) relates to Unit 2 "Assessing Community Risk" taught in the *Leading Community Risk Reduction course* (National Fire Academy [NFA], 2003, p. SM2-60).

This research project relates to the United States Fire Administration operational objective "to promote within communities a comprehensive, multi-hazard risk-reduction plan led by the fire service organization" (NFA, 2003, p. II-2). The LAFD must continue to work on expanding the PAD program throughout the City of Los Angeles.

Literature Review

The historical information regarding the implementation of the public access defibrillation program for the City of Los Angeles was derived from a review of unpublished internal documents and interviews. The literature reviewed for this research consisted of newspapers, fire and EMS journals, search of related areas via the Internet, concurrent with standards, regulations, and policies published by federal, state and local agencies.

The purpose of this literature review is to evaluate the current level of emergency medical service being provided by the LAFD and providing supporting evidence to expand the placement of AEDs in high-risk public access facilities. In addition, developing a cadre of instructors to educate and train individuals on the use of cardiopulmonary resuscitation and AEDs to treat victims of SCA. There are five questions that must be addressed. Does early defibrillation save lives? What impact does response times and Fire/EMS service levels have on public access defibrillation? What public access facilities are the most advantageous to locate AEDs. What is the cost for AEDs, installation and training? Are there legal liabilities attached to the use of AEDs by the public?

During the past five years, the LAFD has observed an average increase of approximately 10,000 incidents per year, reaching a high of 352,526 incidents for the calendar year 2003. This statistic greatly impacts the ability of LAFD resources to arrive on scene of an emergency medical incident in a timely manner (Wells, 2004).

The City of Los Angeles is facing another budgetary shortfall for the coming year due to economic problems. One method to supplement LAFD resources and reduce the risk to the community is the placement of AEDs in high-risk public access facilities. This applied research project will address the specifics of expanding the Public Access Defibrillator program by increasing AEDs in appropriate public facilities throughout the City of Los Angeles.

Does early defibrillation save lives?

Most people can survive sudden cardiac arrest (SCA) if bystanders act quickly to start the Chain of Survival. The Chain of Survival consists of the actions needed to treat a life-threatening emergency. The adult Chain of Survival has four vital links:

1. Early Access - Recognizing that an emergency exists and quickly phoning emergency medical services (EMS) through 911. Early access of EMS is critical since it enables CPR and defibrillation trained and equipped personnel to arrive at the victim's side more rapidly and enables trained emergency dispatchers to coach bystanders in the provision of CPR until help arrives.
2. Early CPR – Starting CPR immediately after cardiac arrest. Early CPR is critical since it provides blood and oxygen to the brain and heart for a few extra minutes so that defibrillation and advanced care can be effective.
3. Early Defibrillation – Defibrillating the victim as soon as the AED arrives. Early defibrillation is critical since in most cases of adult cardiac arrest, the heart is in an abnormal rhythm called ventricular fibrillation that can only be reversed by delivering an electrical shock known as defibrillation. Each minute of delay to attempted defibrillation reduces the likelihood of survival. Early defibrillation is most effective within 3 to 5 minutes.
4. Early Advanced Care – Trained healthcare providers arriving quickly to give advanced care is critical since it helps stabilize the victim and prevent recurrence of cardiac arrest.

The third step, delivering an electrical shock to the heart, which is known as defibrillation is recognized as the most critical step in restoring cardiac rhythm and resuscitating a victim of sudden cardiac arrest (American Heart Association, 2004).

A defibrillator is a device used to administer an electric shock through the chest wall to the heart. When a heart attack becomes a full cardiac arrest, the heart most often goes into uncoordinated electric activity called ventricular fibrillation. The heart twitches ineffectively and can't pump blood. The defibrillator delivers electric current to the heart muscle,

momentarily stunning the heart and stopping all activity. This gives the heart an opportunity to resume beating effectively (American Heart Association, 2001).

An advisory statement from the Advanced Life Support Working Group of the International Liaison Committee on Resuscitation (1997) on early defibrillation states:

> Most adults who can be saved from cardiac arrest are in ventricular fibrillation (VF) or pulseless ventricular tachycardia. Electrical defibrillation provides the single most important therapy for the treatment of these patients. Resuscitation science therefore places great emphasis on early defibrillation. The greatest chance of survival result when the interval between the start of VF and the delivery of defibrillation is as brief as possible. To achieve the earliest possible defibrillation, the International Liaison Committee on Resuscitation endorses the concept that in many settings nonmedical individuals should be allowed and encouraged to use defibrillators (p. 95).

In a *SOS Technologies* (2003) newsletter on automated external defibrillators, it states:

> The goal of an early defibrillation program is to achieve a 3-4 minute response time from collapse of the patient to arrival of the defibrillator and delivery of the first defibrillation shock. This response time goal is based on several factors. The U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) requires treatment within 3-4 minutes for life-threatening events. The American Heart Association recommends defibrillation response times from 3-5 minutes, depending on the environment. The Department of Health and Human Services and the General Services Administration identify 3 minutes or less as the "optimal response time" for an early defibrillation program (p. 1).

Taken from the *American Red Cross, In the News,* Orfinger (2001) states:

> According to Scott Conner, Vice President of the American Red Cross' Health, Safety and Community Services, defibrillation has the most life-saving potential when administered within four minutes of cardiac arrest. After ten minutes of cardiac arrest, very few resuscitation attempts are successful, which shows that the most important element in the treatment of SCA is providing rapid defibrillation therapy (p. 1).

In another article from the *American Red Cross, In the News,* Gillespie (2002) published:

> "Conducted over a two year period at three Chicago airports, the study recorded a 67 percent survival rate among those who experienced sudden cardiac arrest (SCA) and received cardiopulmonary resuscitation (CPR) and AED treatment within five minutes" (p.1).

In *Occupational Health & Safety,* Altmann (2001) narrates the following story:

> Richard Cook is forever grateful that management as his company decided to purchase an AED. His life was saved from the deadly onset of sudden cardiac arrest when emergency medical staff at his company used an AED.
>
> Shortly after arriving to work, Mr. Cook collapsed. Two security team members arrived within two minutes and assessed that Richard was unconscious, not breathing, and no pulse. One of the security guards opened the device and placed the electrodes on Richard's bare chest. Richard was administered a lifesaving shock and converted his heart to normal rhythm after 3 shocks from the AED, followed by CPR (p. 82)

In *SaraMed News*, Grady (2004) found the following:

> In two studies, one conducted at casinos and the other on airliners, survival rates were 53 percent and 40 percent for people who had cardiac arrest and who were treated almost immediately with portable defibrillators, a smaller version of the electrical paddles used in emergency rooms. Those survival rates are far greater than overall rates in the United States, which are dismally low, 2 percent to 5 percent, because most victims are not defibrillated fast enough. Ideally, the shock to the chest should be given within three minutes of the victim's collapse and is unlikely to work after ten minutes (p.1).

In *Public Access Defibrillation League*, Cooper (1999) states:

> Quick use of defibrillators in treating heart attack victims can double a patient's survival rate. Early defibrillation is the single most important event in improving survival from adult cardiac arrest. Its efficacy decreases rapidly over time, with survival decreased by about 10 percent per minute for every minute that defibrillation is delayed (p.1).

The American College of Emergency Physicians (ACEP) believes that the efficacy of early defibrillation with the reliable technology of current AEDs is proven and widely accepted within the out-of-hospital provider community. ACEP endorses the widespread availability of AEDs and the implementation of early defibrillation programs coordinated with an EMS delivery system. In addition, the Citizen CPR Foundation urges all communities to implement and monitor effective emergency cardiac care systems that address each link in the Chain of Survival. This includes early defibrillation capabilities to ensure that personnel trained in CPR and capable of providing defibrillation can arrive at the victim's side within minutes of cardiac arrest. Lastly, the National Association of EMS Physicians agree that rapid defibrillation is the

most critical component of cardiac arrest intervention (National Center for Early Defibrillation, 2000).

What impact does response times and Fire/EMS service levels have on public access defibrillation?

The National Fire Protection Association (NFPA, 2002, 1221, 6.4.2 - 6.4.3) states:

> "Ninety-five percent of alarms shall be answered within 15 seconds, and 99 percent of alarms shall be answered within 40 seconds. Ninety-five percent of emergency dispatching shall be completed within 60 seconds" (p. 15).

Furthermore, National Fire Protection Association (NFPA, 2002, 1710, 5.3.3.4.2 – 5.3.3.4.3) states:

> The fire department's EMS for providing first responder with AED shall be deployed to provide for the arrival of a first responder with AED company within a 4-minute response time to 90 percent of the emergency medical incidents. When provided, the fire department's EMS for providing Advanced Life Support (ALS) shall be deployed to provide for the arrival of an ALS company within an 8-minute response time to 90 percent of all emergency medical incidents. This does not preclude the four-minute initial response (p. 9).

The LAFD, between trucks, engines and rescues, has 264 first responder resources capable of responding to an emergency medical incident. In the past ten years, the LAFD has increased its ambulance resource pool from 65 rescues to 115 rescues. Although the LAFD has almost doubled the number of rescues, due to the rising number of emergency incidents, the average response time of 6 minutes for emergency units arriving on scene of Advanced Life Support (ALS) incidents has only improved by 30 seconds over the past five years (Wells, 2004).

Traditionally, the ability to defibrillate was solely in the hands of emergency medical personnel. They were trained to interpret arrhythmias and determine when a shock was needed. Survival depended on the Emergency Medical Services (EMS) system being contacted and arriving quickly (American Heart Association, 2001).

Unfortunately, quick EMS response isn't always possible. Even the very best EMS systems experience delays from heavy traffic, secured buildings, gated communities, large building complexes and high-rises. For example, in New York City where emergency response teams fight extreme traffic, the average arrival time for emergency vehicles is about 12 minutes. Not surprisingly, the cardiac arrest survival rate is less than 2 percent (American Heart Association, 2001).

Today a new generation of defibrillators, called automated external defibrillators (AEDs) makes it possible for trained lay rescuers to deliver defibrillation. Having trained lay rescuers equipped with AEDs in settings where large numbers of people congregate saves precious minutes and improves survival rates for cardiac arrest victims. Facilities such as high-security companies, sports arenas, large hotels, concert halls, high-rise buildings, gated communities, sprawling manufacturing plants and remote sites can benefit from obtaining AEDs and training employees to use them as part of a public access defibrillation (PAD) program (American Heart Association, 2001).

In an article from *Prehospital Emergency Care*, Ornato and Hankins (1999) concluded:

> The rationale for public access defibrillation (PAD) is that there are many densely populated public arenas where conventional emergency medical services systems cannot respond quickly enough. The use of PAD is justified in certain public locations where

> access and response is delayed, simply because there is no other reasonable way to provide early defibrillation at these sites (p. 297-300).

Taken from *Fire Engineering*, Konoza (1999) states:

> The American Heart Association, the American College of Emergency Physicians (ACEP), the National Association of EMS Physicians, the Citizen CPR Foundation, and the International Association of Fire Chiefs (IAFC) believe that public access defibrillation (PAD) using AEDs is the way of the future in providing this vital link in the Chain of Survival (p. 84).
>
> ACEP recommends the implementation of AED programs countrywide. Defibrillation can reverse SCA if delivered within a 10-minute window. According to the American Heart Association, for every minute that an SCA patient goes without defibrillation, the chance of survival decreases by 10 percent, thus the 10-minute window. Although fire and EMS agencies strive for response times of four to five minutes or better, reported patient downtime to "with patient" time can easily be more than 10 minutes. Because of this, AEDs have to become synonymous with first aid and CPR training, thus forming PAD programs. The American Heart Association has estimated that PAD programs can prevent at least 20,000 deaths each year (p. 84).

In *Fire Chief*, Riddle (1998) studied Las Vegas and found:

> In Las Vegas hotels, the total elapsed time from 911 to shock for survivors was only 9.8 minutes, increasing to 12.4 minutes for those who did not survive. In 1994, the total time from 911 to shock was 12.4 minutes in New York City and 16 minutes in Chicago, which has a survival rate of less than 2 percent.

> The quicker the response to cardiac arrest, the better the survival rate. Since area fire departments weren't going to be able to respond any faster to emergencies at hotels and casinos, it made sense to have AEDs at each hotel. Now, visitors who collapse from a heart attack have a 70 percent chance of surviving the event in Las Vegas hotels and casinos (p. 24-26).

In *USA Today*, Davis (2004) states:

> Bystanders performing CPR and using AEDs save as many cardiac arrest victims as highly trained paramedics and send more of them home with normal brain function. Because paramedics often arrive relatively late, the research found the people they save are more likely to suffer brain damage: 78% of those saved by bystanders without paramedics survived with excellent brain function versus 68% of those treated by paramedics (p. 1).

> A second study shows the survival rate of cardiac arrest victims jumps from 14% to 23% when bystanders use an AED to deliver a shock before paramedics arrive (p. 2).

The EMS system in each community is ultimately responsible for delivering emergency care. To make a PAD program most effective, the EMS system should be an active partner in planning a program and in the follow-up of any emergency within the program. The American Heart Association AED implementation guide discusses the following common elements in all AED programs:

1. Program Coordinator – Choosing a dedicated program coordinator is important to implementing a successful AED program. A program coordinator is someone on-site who can be responsible for day-to-day activities of the program. One of the program coordinator's most important responsibilities throughout the implementation is

communicating with key decision-makers, selected program responders, employees, and the public.

2. Support from Decision-makers – During the initial planning phase of an AED program, it is critical to get buy-in from anyone who will influence decisions about the program.

3. Review of State and Local AED Requirements – State and local requirements for AED programs play an important role in setting program constraints. Most states specify what type of responder training is expected, how to work with state and local EMS, and how to maintain or renew the AED program. Some key requirements are:

   - Most state laws require a state-licensed physician to act as a medical supervisor of the program.
   - Most state laws require you to notify local EMS of AED programs or to register AED programs with local EMS.
   - Most state laws require that responders complete a nationally recognized training CPR/AED course for lay responders.

All 50 states have Good Samaritan laws. These provide limited immunity for certain AED program participants. Some states also provide limited immunity for the company or facility that acquires the AED(s), the people providing training, and the person who uses the AED. The federal Cardiac Arrest Survival Act also provides limited immunity for lay rescuers and acquirers of the AED (American Heart Association, 2004).

What public access facilities are the most advantageous to locate AEDs?

Congress passed into law the Public Health Improvement Act, which contains the Cardiac Arrest Survival Act (CASA). The Act was passed on October 26, 2000 and provides for placement of AEDs in all federal public buildings.

According to CASA, the Secretary of Health and Human Services shall establish guidelines with respect to placing AEDs in federal buildings including: Training courses, proper maintenance and testing of devices, appropriate oversight of the training, and coordinating with the local EMS system regarding the placement and use of the devices.

Cardiac Science, Inc. (2004) a leading manufacturer of life-saving automated public access defibrillators, today announced that new California legislation seeking to place AEDs in all state facilities was signed into law by Governor Arnold Schwarzenegger on January 22, 2004. The new law requires the Department of General Services to apply for federal funds for the specific purpose of purchasing AEDs and deploying them within all state-owned and leased buildings.

It is essential to integrate the concept of early defibrillation into an effective emergency cardiac care system. To achieve the goal of early defibrillation, the American Heart Association endorses the position that all emergency personnel should be trained and permitted to operate an appropriately maintained defibrillator. Therefore all emergency ambulances and other emergency vehicles that respond to or transport cardiac patients should be equipped with a defibrillator. The American Heart Association also supports placing AEDs in targeted public areas such as sports arenas, gated communities, office complexes, doctors' offices and shopping malls (American Heart Association, 2001).

An efficient PAD program optimally achieves a 3-minute response time from collapse of a patient to on-scene arrival of the AED with a trained lay rescuer. Using this 3-minute response time as a guideline will help determine where and how many AEDs to place in a location (American Heart Association, 2001).

In communities where all EMS first response vehicles and ambulances equipped with defibrillators cannot arrive on scene to a location within five minutes of a witnessed sudden cardiac arrest, then on-site AEDs are justified. According to the National Center for Early Defibrillation (2000), the following criteria should be considered when establishing the need for an on-site AED program:

1. Does the EMS response time to this location exceed five minutes for more than 10% of responses?
2. Does this location have an at-risk population such as: men age 40 or older; high blood pressure; high cholesterol; sedentary lifestyle, diabetes, personnel with a history of heart disease?
3. Is this location considered a higher-risk location such as: Airports; gaming establishments; golf courses, large industrial sites, shopping malls, sports complexes?
4. Does this location have personnel willing and able to respond to cardiac emergencies to provide CPR and defibrillation?

If the answer to each of these questions is "yes," then it is recommended that the location consider implementing an on-site AED program (p. 2-3).

The Occupational Safety and Health Administration (OSHA, 2003) sites the following criteria for placement of AEDs:

1. AEDs should be conveniently installed to ensure response within 3-5 minutes.
2. Areas where many people work closely together.
3. Areas where electric-powered devices are used.
4. Health facilities where workers may seek treatment for heart attack symptoms.

5. Company fitness facilities.

Onsite AEDs save precious treatment time, and can improve survival odds because they can be used before emergency medical service personnel arrive on scene (p. 12).

The American College of Emergency Physicians (ACEP) supports increased public access to AEDs that is coordinated with community EMS systems and with appropriate training. Logical places for AEDs include police cars, theaters, sports arenas, public buildings, business offices and airports. An increasing number of commercial airplanes are now equipped with AEDs. Chicago's O'Hare International and Midway Airports were the first airports in the United States to provide defibrillators to employees (ACEP, 2003).

Taken from *USA Today*, Davis (1999) states:

> Chicago spent about $500,000 to put emergency defibrillators devices that deliver lifesaving shocks to some victims of cardiac arrest within a minute's walk in airport terminals. Since August 20, 1999, the devices have been used to shock four victims, saving all of the victims of "sudden death." A similar program was implemented in the San Francisco airport (p. 1-2).

Becker (1998) completed a study to describe the public locations of cardiac arrest and to estimate the annual incidence of cardiac arrest per site to determine optimal placement of AEDs. Placement of AEDs to provide public access defibrillation holds the promise of shortening time from collapse to shock for cardiac arrest victims, thereby improving survival. Because it is not realistic to place an AED in every public location, identification of those places in which cardiac arrest most frequently occurs should guide the location of public access defibrillators to maximize their usefulness (p. 2106).

Becker (1998) completed his study in Seattle, Washington over a five-year period. As a result of his study, he identified the following high-risk locations: International airport, golf courses, health clubs, large industrial site, public sports venue and large shopping mall (p. 2107).

In an article from *SaraMed,* (1999) a study was completed that indicated golf courses are among the most common public places where cardiac arrest occurs. Because of their large area and often, remote locations, golf courses are also among the most difficult places for emergency medical teams to reach quickly (p. 1).

Taken from the *Public Access Defibrillation League,* (2000) the author advocates placing AEDs on Amtrak trains:

> Trains, like airplanes, where people may be remote from most sources of emergency medical care, are particularly appropriate places for defibrillators to be installed. The nature of train travel, tracks, which traverse isolated areas, often with limited access to roads, means critical time might be added to a rescue. In conjunction with CPR trained crews and on board cell phones, having an AED will mean that the first three links in the Chain of Survival can occur on board, no matter where the train is en route (p. 1-2).

Taken from the *Public Access Defibrillation League,* Grady (2000) states:

> The shocking truth is that six times more people could be saved from sudden cardiac arrest if small machines called automated external defibrillators were in wide use. The Red Cross hopes to see AEDs on-site anywhere people gather. That includes corporate offices, factories, schools, churches, restaurants, shopping centers, sports arenas and public transit, to name a few.
>
> Studies show that 350,000 die in the United States each year of sudden cardiac arrest, which strikes both men and women. Average age is 65, but sudden cardiac arrest

> can strike people in the 30s and 40s. Just 5 percent of the victims survive. But as many as 100,000 or 30 percent could be prevented through wide distribution of AEDs (p. 1-2).

In another article from the *Public Access Defibrillation League,* (2002) the author states:

> The American Heart Association (AHA) and the American College of Sports Medicine (ACSM) have issued a joint position statement urging health and fitness clubs to implement automated external defibrillation (AED) programs. The AHA and ACSM recommend that AED programs are particularly important for facilities with memberships of 2,500 or more, facilities with special programs for the elderly or people with medical conditions, and facilities in locations where the EMS response time is likely to exceed five minutes.
>
> In unsupervised exercise facilities, for example, those in hotels and apartment buildings, the AHA and ACSM recommend that there should be an overall AED response plan for the host facility that includes the exercise room (p. 2).

Also, taken from the *Public Access Defibrillation League*, Grady (2000) states:

> Many people who suffer a cardiac arrest and would otherwise die can be saved if ordinary people are trained to use defibrillators to shock them back to life. In two studies, one conducted at casinos and the other on airliners, survival rates were 53 percent and 40 percent for people who had cardiac arrest and who were treated almost immediately with portable defibrillators.
>
> Those survival rates are far greater than overall rates in the United States, which are dismally low, 2 percent to 5 percent, because most victims are not defibrillated fast enough. Ideally, the shock to the chest should be given within three minutes of the victim's collapse and is unlikely to work after ten minutes.

> The two new studies, reflect a large trend in the United States to train lay people to use portable defibrillators and make the devices available in large workplaces and public places like sports stadiums, train and ferry terminals, airports, amusement parks, health clubs, community and senior citizen centers and shopping malls (p. 1-2).

Found in *Occupational Hazards*, Smith (1998) states:

> Each year, as many as 350,000 people suffer from sudden cardiac arrest and most die. Little machines with big names are changing that by filling the gap in the chain of survival.
>
> On January 17, 1997, a man collapsed in his daughter's driveway, the victim of sudden cardiac arrest. His daughter, who lost her 32-year old husband to the same condition, called 911. A police cruiser responded two blocks away. The officers used an AED to restart the man's heart.
>
> The surviving patient advocates placing AEDs in all police cars and places where large groups of people live and work such as office complexes, apartment buildings, malls and manufacturing facilities.

Found in *Fitness Management Magazine*, Herbert (1999) discusses:

> A 13-year old girl collapsed and died from congenital heart disease after a roller coaster ride at Bush Gardens, Tampa, Florida. Following her collapse, two Bush Gardens employees, not trained in CPR, arrived and attended to her. A Bush Gardens medical technician finally arrived but did not have an AED. An emergency medical crew was denied entrance to the grounds by a security guard, and once admitted, was led in the wrong direction.

> The child's mother filed suit against Bush Entertainment Group and Bush Gardens Tampa Bay. She contended that the park was negligent in failing to have proper emergency equipment available…. The jury returned a verdict against the park in the sum of $500,000 (p. 26).

What is the cost for AEDs, installation and training?

In determining the cost of a public access defibrillation program, there are a number of factors that must be considered. The National Center for Early Defibrillation (2000) incremental yearly cost of a community's early defibrillation program include:

- Device costs
- Peripheral equipment costs
- Annual maintenance and insurance costs
- Annual AED training costs
- Annual incremental salary costs of program personnel
- Annual event documentation costs
- Annual quality assurance costs
- Annual additional community-wide CPR training

Device costs

Ideally, your community should plan to place enough AEDs to ensure that no more than five minutes elapses from the time the 911 call is made until the first shock is delivered. To do this, you will have to consider the size and general health of your population and the area of your community in square miles. The average cost for an AED is $3,000. Some AED manufacturers and distributors provide lease-to-own options, which cost approximately $200 a month per AED

over a three-year period. Some communities use devices that have been donated or purchased through grants and gifts. Manufacturers expect AEDs to last up to five years.

Peripheral equipment costs

In addition to the costs of the devices themselves, you need to consider the costs of AED accessories such as extra batteries, electrode pads, and cables. The costs of these accessories total approximately $500 per defibrillator. Some AED models also require battery chargers, which cost approximately $200. This equipment will last up to five years with normal use.

Maintenance and insurance costs

Maintenance costs vary according to the type of device. The primary costs associated with maintenance involve replacement of batteries and electrode pads. For each device, you should have two batteries so that you always have a spare. Lead acid batteries, which cost about $150, have to be replaced approximately every two years. Lithium batteries, which cost approximately $100 to $300, have to be replaced every one to five years, depending on the capacity of battery and usage patterns. Pads cost approximately $20 a pair. At least two sets should be kept on hand for each AED because they are discarded after each use. Unused pads should be replaced after two years because they slowly dry out over time. Replacement insurance, warranty, and service contracts may need to be purchased from some manufacturers.

Training costs

Costs associated with training may include the following:

1. Instructor fees
2. Student fees
3. CPR manikins
4. AED trainers, which cost from $400 to $1,000, including accessories

5. Computer cards that are inserted into the AED that allow it to function as a training simulator and cost approximately $200
6. Educational materials (videos, educational booklets)
7. Electrode pads

Salaries of program personnel

Salaries may or may not be a factor to consider in your community. Some communities have volunteer responders and so incur no salary costs. Others have to pay salaries to responders, instructors and administrative support staff.

Even documentation costs

Each time a cardiac arrest occurs, the key time points and clinical variables should be entered into a database. This allows an understanding of system performance and an evaluation of the effect of any system changes. The cost of time dedicated to data entry should be calculated as a program cost.

Quality assurance tools

Communities that invest in improvements in early defibrillation capabilities should take the time to evaluate the impact of this investment on survival. This means consistently collecting data on each and every case of out-of-hospital cardiac arrest. Administration of data collection and generation of reports will require staff time. This time must be included in the budget.

Community-wide CPR training

Another factor to consider is the cost of training the local community in CPR. A strong CPR program aiming to have more or less 50 percent of the adult population trained in CPR will help increase the number of survivors and the effectiveness of the entire program.

The American Heart Association (2001) has a goal of helping businesses and other facilities establish PAD programs to reduce the time to defibrillation and improve the cardiac arrest survival rates. In providing information about AEDs, the AHA does not recommend one device over another but the AED selected must have Federal Drug Administration (FDA) approval. Some of the elements of a PAD program are:

1. Training designated rescuers in CPR and how to use an AED. The AHA has developed the Heartsaver AED course, which is available through Community Training Centers in most cities. The course lasts about 3½ - 4 hours with participants receiving a course completion card after successfully demonstrating skills proficiency through written and performance evaluation.
2. Having physician oversight to help ensure quality control. The FDA requires a physician's prescription to buy an AED. The AHA recommends further physician involvement to provide medical oversight of the PAD program and to help ensure the program's safety and effectiveness.
3. Integrating with the local EMS system. The local EMS needs to know where AEDs are placed in a facility. The public dispatch office may be able to add the AEDs location to their 911 computer screen.

In California, under Senate Bill 911 (1999) requires implementers of public access AED programs to provide specific training to employees who may use the devices. Under the AED program currently implemented in the City of Los Angeles, employees trained to use AEDs fall into two categories. First, are personnel employed and compensated to provide medical assistance such as physicians, paramedics and firefighters. Second, are personnel trained to use an AED, but not employed or compensated to render medical assistance. City of Los Angeles

staff not employed to render medical assistance will participate in AED training as volunteers, similar to existing first aid and CPR training programs (Dr. Eckstein, personal communication, October 15, 2004).

This training, at a minimum, requires four hours of cardiopulmonary resuscitation (CPR) training and four hours of AED training. Additionally, CAL/OSHA may require two hours of training on the prevention of disease transmission. Periodic re-certification training and routine demonstrations of proficiency are also required. Under Phase One of the PAD program, the cost to provide CPR and AED training to 375 employees was $33,750, or $90 per individual, with an annual recurring cost of $7,125 for CPR refresher courses (Dr. Eckstein, personal communication, October 15, 2004).

The cost to purchase 62 AED units with accessories was $248,000 at $4,000 per AED unit with accessories. Annual recurring costs including battery and pad replacements were $12,400 or approximately $200 per AED. In addition, costs for wall signage and phone stickers for all facilities were $2,400. Costs to install the devices were tasked to the City's General Services Department, normally responsible for all carpentry work for city facilities. Due to the proposed size of the public access AED program, an AED Program Manager was funded at an annual cost of $51,615. This position would work under the supervision of the LAFD's Medical Director and is responsible for overall program design and coordination, ensuring appropriate equipment tracking and maintenance, required record keeping and the implementation of appropriate training (Dr. Eckstein, personal communication, October 15, 2004).

A survey was distributed to metropolitan fire departments in California to solicit information regarding AED and training costs. The cost of an AED ranged from a low of $2,000 to a high of $4,000 including accessories. Training costs were normally passed onto the

respective public access site where AEDs were installed. San Jose was the only fire department outside of Los Angeles that responded with a cost. The San Jose Fire Department spent $50,000 for their PAD program with an annual on-going cost of $15,000. The results of the survey can be found in Appendix A.

Are there legal liabilities attached to the use of AEDs by the public?

Taken from the *National Center for Early Defibrillation,* Lazar (2000) states the following regarding negligence when using an AED:

> For a sudden cardiac arrest victim or a relative to successfully sue an AED purchaser or user for negligence, four essential legal elements must be proven. These include duty, breach of duty, causation of injury, and legally recognized damages. A negligence claim cannot succeed if any one of these elements is missing.
>
> Duty in negligence law is defined as "an obligation, to which the law will give recognition and effect, to conform to a particular standard of conduct toward another." If a legal duty is found to exist, it is possible for liability to be imposed. In the absence of a legal duty, no liability can be imposed.
>
> A bystander has no legal obligation to provide affirmative medical aid to an ill or injured person, even if the bystander has the ability to help.
>
> A successful negligence lawsuit also requires proof that alleged misconduct caused legally recognized damages such as death or injury. This misconduct can be a result of the failure to use an available AED or the improper use of an available AED. In all cases involving sudden cardiac arrest leading to sudden cardiac death, the element of medical causation will be extremely difficult to prove.

Lazar (2000) also states:

> The Food and Drug Administration (FDA) is the federal regulatory agency responsible for ensuring that medical devices like AEDs are safe and effective. To achieve this goal, the FDA imposes device labeling requirements on AED manufacturers. Labels must describe the indications and conditions for AED use. All AEDs sold in the marketplace today are evaluated and cleared by the FDA.

In reference to the Good Samaritan protection regarding AEDs used by the public, Lazar (2000) states:

> Any person who uses or attempts to use an automated external defibrillator device on a victim of a perceived medical emergency is immune from civil liability for any harm resulting from the use or attempted use of such device.
>
> Immunity does not apply to a person using the device if, the harm resulting from the use of such device was caused by willful or criminal misconduct, gross negligence, reckless misconduct, or a conscious, flagrant indifference to the rights or safety of the victim who was harmed.

Senate Bill 911 (1999) states:

> Existing law provides immunity from civil liability to any person who, in good faith and not for compensation renders emergency care or treatment by the use of an automated external defibrillator at the scene of an emergency, has completed a basic CPR and AED use course that complies with regulations adopted by the EMS Authority and the standards of the AHA or the American Red Cross for CPR and AED use.

Senate Bill 911 was further amended by Assembly Bill 2041 (2002) which states:

> This bill would revise those provisions as stated in Senate Bill 911 by deleting the requirement that a person complete a basic CPR or AED course. The bill would further provide immunity from civil liability to a person or entity that acquires an AED for emergency use and renders emergency care, if that person or entity is in compliance with specified requirements.

Taken from *Occupational Hazards*, Smith (1998) states:

> Liability is a concern whenever the use of AEDs is mentioned. Many corporate attorneys shudder at the thought of nonmedical personnel administering defibrillation to coworkers or company visitors. They envision million-dollar jury verdicts and years spent tied up in courtrooms.
>
> Relax, say AED manufacturers and attorneys familiar with the machines, case law and current legislation. Most AED manufacturers indemnify users, which means that should a victim or his or her family sue the user and win, the manufacturer promises to pay (p. 1).

Procedures

An overview of the current Public Access Defibrillator Program was compared to other Metropolitan departments. An eleven-question survey (Appendix A) was distributed to 14 metropolitan fire departments within the state of California. The fire departments were selected using the following criteria: size and geographical location of the department.

Questions contained in the survey were developed to solicit feedback on current Public Access Defibrillator Programs within each department. The first two questions were to determine if each department had a PAD program and, if not, briefly explain the reasons for not

having a PAD program. Only those departments that had a PAD program would continue to answer the remaining questions in the survey. An assessment of the length of each department's PAD program was followed by a question of the public access locations where AEDs were located. A question of who the AED department coordinator was for each department followed by a question of who the site coordinator was for each location. A question of the cost of the PAD program was asked followed by a question of the cost to purchase and install an AED. Finally, a question as to whether the PAD program has had an impact on the community was followed with the brand of AED installed.

The research methodologies utilized for this Applied Research Project were historical and evaluative. The principle procedures employed in this research project were: a review of the literature; personal interviews; searches of related areas via the Internet; an analysis of federal, state, and local laws; and an analysis of the current LAFD Public Access Defibrillator Program. All of the above items were reviewed and analyzed for their correlation to this applied research project.

Definition of Terms

Advanced Life Support (ALS) – A standard of care involving physician directed and approved methods of care that are provided by responders at the paramedic level.

Automatic External Defibrillator (AED) – A small portable device that administers an electrical shock to the heart of certain cardiac arrest victims.

Cardiac Arrest – The loss of effective pumping action of the heart, caused by life threatening rhythms.

Cardiac Chain of Survival – Early access to care, early CPR, early defibrillation, and early advanced care.

Cardio Pulmonary Resuscitation (CPR) – Providing manual heart stimulation and forced respiratory ventilation.

Defibrillation – Using electrical stimulation to shock the heart back into a normal rhythm.

EMS – Emergency Medical System

Emergency Medical Technician (EMT) – A first responder level of care, which is the level below that of a paramedic.

First Responder – Functional provision of initial assessment and basic first-aid intervention, including CPR and AED capability.

LAFD – Los Angeles Fire Department

NFPA – National Fire Protection Association

Public Access Defibrillation (PAD) – Providing automatic external defibrillators for public use in areas of public activity.

Ventricular Fibrillation (VF) – A rapid chaotic contraction of the heart that causes the heart to quiver. The electrical activity of the heart is completely disorganized.

Ventricular Tachycardia (VT) – A condition caused by electrical disturbances in the heart that cause a dangerously rapid heart rate. It is often the precursor to ventricular fibrillation.

Interviews

A personal interview was conducted with Dr. Marc Eckstein, Medical Director, Los Angeles Fire Department, 200 North Main Street, Los Angeles, California. The purpose of this interview was to gain background information concerning the implementation and current status of the PAD program for the City of Los Angeles. Dr. Eckstein was asked specific questions on a

PAD program and this information is included in the Background & Significance, Literature Review and Results sections of this Applied Research Project.

A telephonic interview was conducted with Deputy Chief Perry Peake, EMS Director, San Diego Fire-Rescue Department, 1010 2nd Avenue, San Diego, California. The purpose of this interview was to gain background information concerning the implementation and current status of the PAD program for the City of San Diego. San Diego was selected because of the success of their PAD program. Chief Peake was asked specific questions on the PAD program and this information is included in the Results and Appendix of this Applied Research Project.

A telephonic interview was also conducted with Captain Tony Magallon, San Jose Fire Department, 801 North 1st Street, San Jose, California. The purpose of this interview was to gain background information concerning the implementation and current status of the PAD program for the City of San Jose. San Jose was also selected due to the level of AEDs in public access locations. Captain Magallon was asked specific questions on the PAD program and this information is included in the Results and Appendix of this Applied Research Project.

Assumptions and Limitations

Based on Federal and State laws requiring the placement of AEDs in public access facilities, it is assumed that early defibrillation saves lives. A second assumption is that Public Access Defibrillation Programs will improve the survival rate for sudden cardiac arrest patients.

The research of metropolitan departments was limited to fire departments in California taking into account specific California Laws. Surveys were distributed to 14 fire departments throughout California, of which 8 responded. Of the 8 that responded, only six had implemented a PAD program. Although there are a number of factors related to implementing a PAD Program, the research was limited to evaluating the effectiveness of AEDs for public use.

Results

Research Question 1: Does early defibrillation save lives?

Sudden cardiac arrest can happen anywhere, to anyone, at any time, without warning, without symptoms, and regardless of age or general health. We have learned that SCA is most often caused by ventricular fibrillation, an irregular quivering heart rhythm. The patient stops breathing and no pulse is present. Defibrillation, an electric shock to the heart, is the only effective treatment for VF.

The results show that surviving SCA is largely dependent on how quickly the patient is defibrillated. For each minute that defibrillation is delayed, the patient's chance of survival decreases by seven to ten percent. The research shows that the patient suffers irreversible brain damage within four to six minutes after cardiac arrest. After ten minutes, few victims of SCA survive.

In the Chain of Survival, there are four vital links: Early Access, Early CPR, Early Defibrillation, and Early Advanced Care. Our research has determined that the third step, delivering an electrical shock to the heart, which is known as defibrillation is recognized as the most critical step in restoring rhythm and resuscitating a patient of sudden cardiac arrest.

Numerous studies support that by providing defibrillation within five minutes to a victim of sudden cardiac arrest the chance for survival will greatly increase. One-study states that the quick use of defibrillators in treating heart attack victims can double a patient's survival rate.

In addition, the goal of an early defibrillation program is to achieve a 3-4 minute response time from collapse of the patient to the arrival of the defibrillator and delivery of the first defibrillation shock. This response time goal is corroborated by the U.S. Department of Labor's

OSHA, the American Heart Association, the American Red Cross, the Department of Health and Human Services and the General Services Administration.

The results of this study are very conclusive in determining that early defibrillation does save lives. The earlier a victim of SCA receives a required shock from a defibrillator, the better chance that the victim has for surviving.

Research Question 2: What impact do response times and Fire/EMS service levels have on public access defibrillation?

As stated previously, the NFPA (2002) establishes a standard for fire department's EMS first responder with AEDs shall be deployed to provide for the arrival of a first responder with AED company within a 4-minute response time to 90 percent of the emergency medical incidents.

Unfortunately, quick EMS response isn't always possible. Even the very best EMS systems experience delays from heavy traffic, secured buildings, gated communities, large building complexes and high-rises. Occupational Safety and Health Administration (2003) indicated that on average, waiting for the arrival of emergency medical system personnel results in only a 5-7 percent survival. New York City for example, the average time for emergency vehicles is approximately 12 minutes, with a cardiac arrest survival rate of less than two percent. The LAFD faces similar time delay obstacles that affect response times. Wells (2004) reported that the average response time for emergency units arriving on scene of an ALS incident is six minutes.

Regrettably, as Los Angeles and other metropolitan cities continue to grow, response times will continue to be delayed. Budgetary restraints prevent the majority of cities from expanding the resource pool to meet the ever critical 4-5 minute response time.

Ornato and Hankins (1999) concluded that there are many densely populated public areas where conventional emergency medical services systems cannot respond quickly enough, thus establishing the rationale for public access defibrillation. The use of a PAD program is justified in certain public locations where access and response is delayed, simply because there is no other reasonable way to provide early defibrillation at these sites.

The American Heart Association (2001) published a report showing that public access defibrillation programs, in which lay rescuers provide CPR and use AEDs, can increase survival from sudden cardiac arrest. The study documents a 67 percent survival rate for witnessed sudden cardiac arrest victims who received bystander CPR and treatment with an AED within five minutes.

Furthermore, the American Heart Association (2001) supports the establishment of public access defibrillation programs if an emergency medical service call-to-shock time interval of less than five minutes cannot be achieved with conventional EMS service.

The data presented in the literature review led the authors to suggest a connection between response times and successful defibrillation. The data also indicates that public access facilities where EMS response may be delayed, establishing a PAD program will enhance the survival rate of victims of sudden cardiac arrest.

Research Question 3: What public access facilities are the most advantageous to locate AEDs?

The data presented in the literature review identified two common circumstances by the authors for determining the need for AEDs in public access facilities. The first is EMS response times to a location that exceed five minutes for more than ten percent of responses. The second is a location having an at-risk or high-risk population.

President Clinton signed into law the Cardiac Arrest Survival Act (2000) that provides for the placement of AEDs in all federal buildings. At the direction of President Clinton, the Department of Health and Human Services developed guidelines for AED placement in federal facilities. These guidelines provide a template for federal agencies to establish AED programs. The guidelines also provide a valuable reference for other public and private organizations establishing AED programs.

The American College of Emergency Physicians (2003) supported increased public access to AEDs that is coordinated with community EMS systems and with appropriate training. Logical places for AEDs include police cars, theaters, sports areas, public buildings, business offices and airports.

Becker (1998) completed a study to describe the public locations of cardiac arrest and determine optimal placement of AEDs. Because it is not realistic to place an AED in every public location, identification of those places in which cardiac arrest most frequently occurs should guide the location of PAD programs to maximize their usefulness. As a result of his study, he identified the following high-risk locations: International airports, golf courses, health clubs, large industrial sites, public sports venues and large shopping malls.

The Public Access Defibrillation League (2000) advocates the placement of AEDs on Amtrak trains. Trains, like airplanes, where people may be remote from most sources of emergency medical care, are particularly appropriate places for defibrillators to be installed. In conjunction with CPR trained crews and on board cell phones, having an AED will cause the first three links in the Chain of Survival to occur on board, no matter where the train is en route.

Taken from *Fire Engineering* (1999) Konoza states:

> The American Heart Association, the American College of Emergency Physicians, the National Association of EMS Physicians, the Citizen CPR Foundation, and the International Association of Fire Chiefs believe that public access defibrillation using AEDs is the way of the future in providing the vital third link in the Chain of Survival (p. 84).

From *USA Today* (1999) Davis states:

> Chicago airport was the first International airport to place AEDs inside the terminal. It is an effort that is being copied at airports across the nation. Initial implementation paid off with surprisingly quick results with four lives saved in less than five weeks (p. 1).

The City of Los Angeles has implemented a public access defibrillator (PAD) program in two phases. Phase one implementation placed AEDs and provided training for one City owned high rise building, all municipal golf courses and the Los Angeles Zoo. Phase two placed AEDs and provided training in two other City owned high rise buildings, the Los Angeles Police Department headquarters facility, the Los Angeles Convention Center and the Downtown Main Library.

A review of Appendix A reveals of the six fire departments that responded to the survey and have implemented PAD programs, the San Diego and San Jose fire departments have the most successful programs. In less than three years, the San Jose Fire Department has implemented a PAD program in Federal building, City buildings, airports, public buildings, parks and recreation areas, and athletic facilities. The San Diego Fire Department through its project “Heart Beat” has implemented a PAD program in Federal buildings, City buildings,

airports, public buildings, golf courses, parks and recreation areas, athletic facilities, public schools and colleges.

An unexpected finding that was discovered during this applied research project was that the City of Los Angeles could only require AEDs in City owned facilities. In Federal or State building where AEDs are installed, each agency establishes its own medical director for their respective PAD programs. All other public access facilities would have to decide on its own whether to install AEDs or not.

Research Question 4: What is the cost for AEDs, installation and training?

The research revealed that there are a number of AED manufacturers and selecting an AED remains each fire department's preference. Normally, AEDs are selected based on size, simplicity of use, and cost. The various types of AEDs used by the fire departments in the survey were: Philips HeartStart FR-2, Cardiac Science Powerheart G3, Zoll AED, and Medtronic LifePak. Prior to distribution, the American Heart Association must approve AEDs, with costs ranging from $2,000 to $4,000. Contributing to the variance of cost were accessory items such as extra batteries, electrode pads and cables. Some AED modes also require battery chargers, which cost about $200. For the City of Los Angeles, the cost to purchase an AED was $4,000 per unit, which also included accessories. Annual recurring costs including battery and pad replacement was approximately $200 per AED.

Costs for the installation of AEDs in public facilities could not be accurately calculated due to several factors. In the City of Los Angeles, the installation of AEDs in public facilities was tasked with the City's General Services Department. This department is responsible for all carpentry work for city facilities including the installation of AEDs. The Oakland Fire Department, San Diego Fire Department and San Francisco Fire Department tasked the

installation and cost to each specific site where the AEDs were located. Both Long Beach Fire Department and Ventura County Fire Department did not have the cost analysis available. The one fire department that did provide a cost included the cost of AEDs, training and installation. Based on the information obtained in the survey, accurate costs for installation could not be obtained.

The research revealed associated costs with training may include: Instructor fees, student fees, CPR manikins, AEDs, computer cards, educational materials, and electrode pads.

According to Dr. Eckstein, in the City of Los Angeles, under phase one of the PAD program, the cost to provide CPR and AED training to 375 employees was $33, 750, or $90 per individual. In addition, there was an annual reoccurring cost of $7,125 for CPR refresher courses. In addition, due to the proposed size of the public access AED program, an AED Program Manager was funded at an annual cost of $51,615. This position would work under the supervision of Dr. Eckstein and is responsible for overall program design and coordination, ensuring appropriate equipment tracking and maintenance, required record keeping and training. In addition current training is conducted through paying staff members in other assignments overtime to provide the training. There is no additional staffing to assist the Program Manager in managing the PAD program for the City of Los Angeles.

For the Oakland Fire Department, San Diego Fire Department and San Francisco Fire Department, the cost of training was passed onto each respective public facility site. San Jose Fire Department, as stated above, gave a figure of $50,000 which included the cost of AEDs, installation and training. The results of the survey can be found in Appendix A.

Research Question 5: Are there legal liabilities attached to the use of AEDs by the public?

Lazar (2000) stated for a sudden cardiac arrest victim or a relative to successfully sue an AED user for negligence, four essential legal elements must be proven. These include duty, breach of duty, causation of injury, and legally recognized damages. A negligence claim cannot succeed if any one of these elements is missing.

Lazar (2000) further stated that duty in negligence law is defined as "an obligation, to which the law will give recognition and effect, to conform to a particular standard of conduct toward another." If a legal duty is found to exist, it is possible for liability to be imposed. In the absence of a legal duty, no liability can be imposed. A bystander has no legal obligation to provide affirmative medical aid to an ill or injured person, even if the bystander has the ability to help.

Lazar (2000) also discusses the Good Samaritan protection regarding AEDs used by the public which states: "Any person who uses or attempts to use an AED device on a victim of a perceived medical emergency is immune from civil liability for any harm resulting from the use or attempted use of such device."

California Senate Bill 911 (1999) provides immunity from civil liability to any person who, in good faith and not for compensation renders emergency care or treatment by the use of an AED at the scene of an emergency. They must have completed a basic CPR and AED use course that complies with regulations adopted by the EMS authority and the standards of the American Heart Association or the American Red Cross for CPR and AED use.

Senate Bill 911 was further amended by Assembly Bill 2041 (2002) by revising the provisions stated in Senate Bill 911 by deleting the requirement that a person complete a basic CPR or AED course.

Altmann (2001) found while there has not been significant litigation regarding AEDs, there have been a few cases involving the failure to have or use an AED. A Florida jury found Busch Gardens negligent in June 1999 for failing to have essential medical equipment, including an AED, on the premises. The family of a teenage girl was awarded $500,000 in damages for her death. Given the relatively small cost of an AED and the growing recognition of its effectiveness in treating sudden cardiac arrest, these devices are becoming the new standard of care in responding to cardiac emergencies.

Konoza (1999) discusses another case where Lufthansa Airlines was found negligent for failing to provide "timely treatment" to a passenger who suffered a cardiac emergency. In this case, the plaintiff was awarded $2.7 million. As a result, numerous United States companies have become AED customers.

Smith (1998) conveys that in addition to state and federal protection, most AED manufacturers indemnify users, which means that should a victim or his or her family sue the user and win, the manufacturer promises to pay.

With the passage of state and federal laws that protect a person from liability when using an AED, the greater risk for public access facilities now lies in not having an AED onsite.

Discussion

On a day to day basis, it is all but impossible to predict who will have a sudden cardiac arrest, or where and when it will happen. According to the American Heart Association (2001) about 220,000 people die each year from sudden cardiac arrest. That's 600 a day or an average of 25 per hour. The American Heart Association estimates that 20,000 or more deaths could be prevented each year if automatic external defibrillators were more widely available to first line responders such as police officers and fire department personnel.

In the City of Los Angeles, as in many other communities, dialing 911 activates the emergency medical system, which dispatches the appropriate emergency personnel to the scene. This process is the beginning of the cardiac chain of survival, which consists of a set of four crucial links in the emergency treatment of sudden cardiac arrest.

According to the American Heart Association (2001) the most crucial of the four links is early defibrillation. For each minute of delay in returning the heart to its normal pattern of beating decreases the chance of survival by ten percent. After as little as ten minutes, very few resuscitation attempts are successful. Although defibrillation does not work all of the time, it does work at a high rate when defibrillation efforts begin quickly.

The literature review disclosed that in cases of sudden cardiac arrest where ventricular fibrillation or ventricular tachycardia are present CPR and immediate cardiac defibrillation increase the survivability of patients. The goal of an early defibrillation program is to achieve a 3-4 minute response time from collapse of the patient to arrival of the defibrillator and delivery of the first defibrillation shock. The United States Department of Labor's OSHA requires treatment within 3-4 minutes for life-threatening events. The American Heart Association recommends defibrillation response times from 3-5 minutes. The Department of Health and Human Services and the General Services Administration identify three minutes or less as the "optimal response time" for an early defibrillation program.

Gillespie (2002) published an article discussing a study over a two-year period at three Chicago airports. The study recorded a 67 percent survival rate among those that experienced sudden cardiac arrest and received CPR and AED treatment within five minutes.

The data presented by the cited authors indicate a connection between response times and successful defibrillation. It is apparent that the average response time of six minutes for Los

Angeles Fire Department emergency resources responding to EMS incidents is insufficient. In the City of Los Angeles, these response times are delayed by extreme traffic, secured buildings, gated communities, large building complexes and high-rises.

With this in mind, Ornato and Hankins (1999) concluded where conventional EMS systems cannot respond quickly enough, the need for public access defibrillation is justified. The use of PAD is justified in certain public locations where access and response is delayed simply because there is no other reasonable way to provide early defibrillation at these sites.

In addition to mandated AEDs in Federal and State buildings, the American Heart Association (2001) supports placing AEDs in targeted public areas such as sports arenas, gated communities, office complexes, doctor's offices and shopping malls.

The American College of Emergency Physicians (2003) supports increased access to AEDs in police cars, theaters, sports arenas, public buildings, business offices and airports. The research has revealed that any public access facility that is used by large numbers or any public access facilities where workers are a higher risk are excellent candidates for public access AEDs. The results of the survey support installing AEDs in public access locations.

In establishing a PAD program, there are specific elements that are required. According to the American Heart Association (2001), elements of a PAD program include training designated rescuers in CPR and how to use an AED, medical oversight, and maintenance of equipment. There are Federal and State laws that protect the trained rescuer as well as a lay person that may act and place an AED into operation during an emergency.

Senate Bill 911 (1999) provides immunity from civil liability to any person that renders emergency care or treatment by the use of an AED and has completed a basic CPR and AED course. This provision applies to trained emergency responders. Senate Bill 911 was further

amended by Assembly Bill 2041 (2002) by deleting the requirement that a person complete a basic CPR or AED course. Thus the average lay person could opt to place an AED into operation without fear of any legal liability recourse by the patient or relative.

How do the results of the research affect the City of Los Angeles? The Los Angeles Fire Department is not anticipating an increase in emergency resources in the near future, in fact, the City of Los Angeles is facing another year of budgetary deficit. In addition, funding for the current implemented PAD program in Los Angeles does not include staffing for training personnel to use AEDs.

The LAFD response times for emergency resources are not meeting the NFPA standards and constantly putting the lives of sudden cardiac arrest patients at risk. Establishing a comprehensive PAD program throughout the City of Los Angeles will supplement the LAFD resources when responding to EMS incidents. The current distribution of AEDs throughout the city is inadequate to meet the needs of the community.

Recommendation

Early bystander CPR and rapid defibrillation are the two major contributors to survival of victims of sudden cardiac arrest. Automatic external defibrillation is one of the most promising methods of achieving rapid defibrillation. In public access defibrillation, the technology of defibrillation and training in its use are accessible to the community. The Los Angeles Fire Department believes that a PAD program is the next step in strengthening the cardiac Chain of Survival. A PAD program should include operating an AED by lay persons, firefighters, police, security personnel and non-physician care providers in the community.

Based on this study, it is recommended that the LAFD partner with city officials in identifying funding to expand the PAD program in city facilities. The first priority would be the

airports, followed by high rise office buildings, and public transit systems. In addition, training members of the Los Angeles Police Department and placing AEDs in all patrol cars.

Furthermore, the LAFD Medical Director, Dr. Eckstein would continue to manage the PAD program for the City of Los Angeles. In conjunction with expanding the PAD program in Los Angeles, additional staff members would have to be budgeted for in the LAFD to continue to provide adequate and consistent training.

It is also recommended that an ordinance be drafted and implemented requiring the placement of AEDs in all-high rise office and residential buildings, schools, shopping centers and sports arenas.

The final element of a successful PAD program would be working with medical manufacturers, legislators and governmental agencies to promote safety and efficiency, reduce costs and update training requirements to facilitate implementation of PAD. Additionally, a legal assessment of establishing a partnership with a manufacturer similar to the program implemented in San Diego could assist in reducing costs of AEDs.

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APPENDIX A

PUBLIC ACCESS DEFIBRILLATOR PROGRAM SURVEY

1. Does your Department have a Public Access Defibrillator (PAD) Program?

☐ Yes ☐ No

2. If "No", can you please briefly explain why not?

_____

If "Yes", Please answer the following:

3. How long have you had a PAD Program?

___ Less than One Year ___ 1 – 2 Years ___ 3 – 5 Years __ Over 5 years

4. Where do you have the Automated External Defibrillators (AED) located?

Federal Buildings	___
City Buildings	___
Airports	___
Public Buildings	___
Golf Courses	___
Recreational Parks	___
Athletic Facilities	___

Others (Please explain)

_____

5. Who is the AED Department Coordinator?
Name _____ Rank _____ Phone _____

6. Who is the Site Coordinator for each location?

_____

7. What is the cost of your program? Can you explain?

_____

8. What is the cost to purchase and install one AED?

_____

9. Has your program had an impact on the community (i.e. Saves)?

_____

10. What brand of AED are you installing? Why?

_____

11. Any additional comments?

_____

Appendix A Results

Number	LAFD	Long Beach	Oakland	San Diego	San Francisco	San Jose	Ventura County
1	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2							
3	1-2 Years	3-5 Years	1-2 Years	1-2 Years	3-5 Years	1-2 Years	3-5 Years
4	City Buildings Golf Courses Zoo	City Buildings Public Buildings Airport	Federal Buildings City Buildings Airports Athletic Facilities	Federal Buildings City Buildings Airports Public Buildings Golf Courses Rec and Parks Athletic Facilities Colleges, schools	City Buildings Airports Public Buildings Golf Courses Athletic Facilities	Federal Buildings City Buildings Airports Public Buildings Rec and parks Athletic Facilities	City Buildings Public Buildings Golf Courses
5	Dr. Marc Eckstein Medical Director LAFD	Mike Sarjeant, Captain, EMS Div Long Beach FD	Jean English, RN EMS Division Oakland FD	Maureen O'Conner, EMT San Diego FD	Dr. Marshal Isaacs, Medical Director, SFFD	Tony Magallon, Captain San Jose FD	Mark Komins, EMS Training Coordinator, VCFD
6	City General Services employees	City Safety Officer	Each site identifies a coordinator	Each site identifies a coordinator	Each site identifies a coordinator	Safety Officers for City buildings All others identify a person	City or Location representative
7	$101,380 for current programs, no future ones	Unavailable	Each site pays for AEDs and training costs	Program paid by fees charged for training and management	Each site pays for the AEDs and training costs	Initial $50,000 on-going $15,000	Unavailable
8	$4,000	Unavailable	Unknown, each site purchases	$2,100	$2,500	$3,850	$2,000
9	Too early to evaluate	2 Saves at different locations	Unknown at this time	15 Saves	Several at different locations	2 Saves at the airport	2 Saves at different locations
10	Philips FR-2	Philips FR-2	Agency purchases	Cardiac Science PowerHeart G3	Philips and Zoll	Philips FR-2	Medtronic LifePak
11	No further funding to expand	Obstacles of time and money	N/A	N/A	N/A	N/A	Community loves it